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EDITORIAL

Adopting Code ICH in intensive care

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Intracerebral hemorrhage (ICH) is an intensive care disease. Burdened by prior attitudes of pessimism and nihilism from medical providers, ICH is now recognized as a treatable condition that requires urgent intervention across multiple aspects of care. Intensivists are in the optimal position to coordinate this care bundle, proposed as Code ICH to emphasize its critical and time-sensitive nature. This represents a paradigm shift in the management of ICH and it is important to recognize why now is the time for Code ICH in intensive care.

ICH is common, accounting for 10–15% of strokes in high-income countries and as much as 40% in low- and middle-income countries (LMIC) [1]. Despite advancements in the management of ischemic stroke, the care for ICH has not seen similar progress and 30-day mortality rates of 40–50% are still quoted [1]. Modern ischemic stroke treatment has required well-defined time-sensitive protocols, but ICH also necessitates similarly protocolized care. Given that most ICH patients present with symptoms of acute stroke or decreased level of consciousness and are diagnosed at the time of emergency imaging (usually with computed tomography, CT), implementing an acute ICH protocol is a natural extension of existing approaches to care.

Code ICH has recently been proposed as a comprehensive, evidence-based protocol aimed at improving outcomes through early and aggressive interventions [2]. Timely intervention is crucial in the management of ICH due to the high risk of hematoma expansion within the initial hours of symptom onset [3]. Studies of individual interventions have suggested benefits for discrete treatments such as blood pressure lowering, coagulopathy reversal, and surgical hematoma evacuation. INTERACT-2 [4] demonstrated the safety and feasibility of aggressive blood pressure control in acute ICH, and pooled analyses of this and other studies indicated that early, smooth and sustained blood pressure reduction as low as 130–140 mmHg could reduce hematoma expansion and improve functional outcomes [5, 6]. This approach has been recommended by the guidelines on ICH endorsed by the American Heart Association (AHA) and the American Stroke Association (ASA) to be started rapidly and achieve the target blood pressure in a smooth and sustained manner [7]. Likewise, coagulopathy reversal aims to reduce hematoma expansion for both vitamin K antagonists (i.e., warfarin) and direct-acting oral anticoagulants [8, 9]. The AHA/ASA ICH guidelines also contain discrete individualized recommendations regarding the reversal of different types of anticoagulant medications [7].

Multiple clinical trials have now also demonstrated the benefit from surgical intervention in carefully selected patients [10, 11]. In particular, the ENRICH clinical trial showed that early minimally invasive surgery for moderate volume lobar ICH improves patient outcome and shortens the length of mechanical ventilation and stay in intensive care unit (ICU) [10].

These efforts have generally involved testing and implementing a singular intervention. However, intensivists recognize that it is often a package of care containing multiple elements that is most important. This "bundle of care" concept is what makes Code ICH both appealing and necessary. Synergy between multiple different interventions appears to have a more powerful impact on the outcome than single interventions considered separately. The INTERACT-3 trial [12] showed that a multifaceted care bundle approach incorporating rapid blood pressure control and coagulopathy reversal, along with glucose and fever control, likely improves outcomes in ICH patients and that this can be done even in resource-challenged environments such as LMIC. These bundles have centered around early time-sensitive decisions including blood pressure lowering, coagulopathy reversal,

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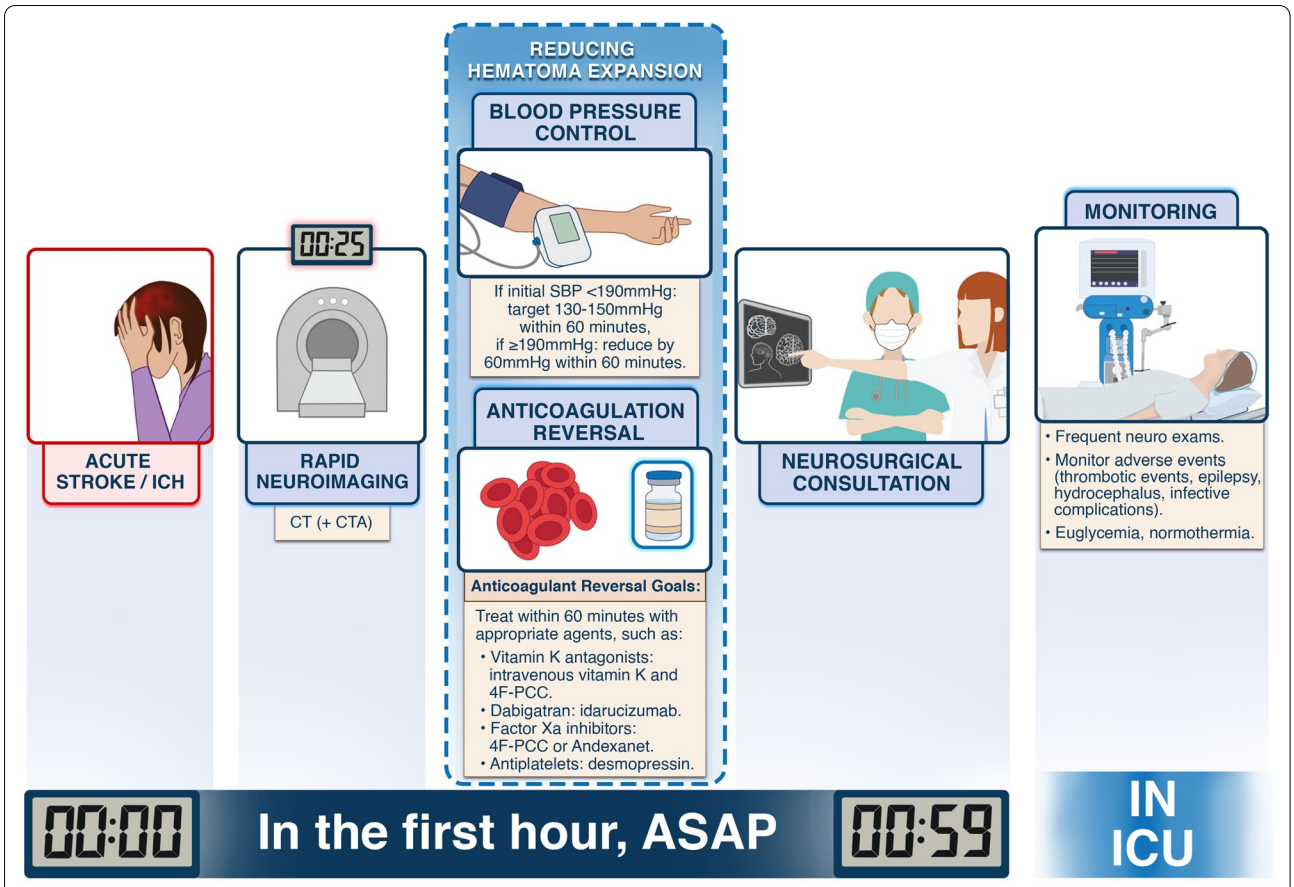
REDUCING HEMATOMA EXPANSION
BLOOD PRESSURE CONTROL
If initial SBP <190mmHg: target 130-150mmHg within 60 minutes, if ≥190mmHg: reduce by 60mmHg within 60 minutes.
ANTICOAGULATION REVERSAL
Anticoagulant Reversal Goals:
Treat within 60 minutes with appropriate agents, such as:
• Vitamin K antagonists: intravenous vitamin K and 4F-PCC.
• Dabigatran: idarucizumab.
• Factor Xa inhibitors: 4F-PCC or Andexanet.
• Antiplatelets: desmopressin.
00:25
ACUTE STROKE / ICH
RAPID NEUROIMAGING
CT (+ CTA)
NEUROSURGICAL CONSULTATION
MONITORING
• Frequent neuro exams.
• Monitor adverse events (thrombotic events, epilepsy, hydrocephalus, infective complications).
• Euglycemia, normothermia.
00:00
In the first hour, ASAP
00:59
IN ICU

Fig. 1 Management of patients. Patients with acute stroke or intracerebral hemorrhage symptoms should undergo immediate brain imaging. Early computed tomography angiography is also crucial for detecting vascular abnormalities that may cause ICH and predicting potential expansion. Imaging Goals are computed tomography within 25 min and CTA for most patients. Early and careful blood pressure management, aiming for specific targets. If initial systemic blood pressure is < 190 mmHg: target 130-150 mmHg within 60 min; if ≥ 190 mmHg: reduce by 60 mmHg within 60 min. In cases of anticoagulation-associated ICH, rapid reversal of anticoagulants is essential due to the high risk of expansion. Anticoagulant Reversal Goals: treat within 60 min with appropriate agents, such as: Vitamin K antagonists: intravenous vitamin K and 4-factor prothrombin complex concentrate (4F-PCC). Dabigatran: idarucizumab. Factor Xa inhibitors: 4F-PCC or andexanet Antiplatelets: desmopressin. Platelet transfusion is not suggested and may be harmful. Initial and serial neurologic evaluations are vital for tracking disease progression and detecting early signs of complications. Optimal timing and techniques for ICH surgery are still under investigation, but early intervention by experienced surgeons using minimally invasive methods may improve outcomes. Maintaining normoglycemia is crucial as both hyperglycaemia and hypoglycaemia worsen outcomes. Regular temperature monitoring and treatment to maintain normothermia are recommended. *CT* computed tomography, *CTA* computed tomography angiography, *ICH* intracerebral hemorrhage, *4F-PCC* 4-factor prothrombin complex concentrate, *SBP* systolic blood pressure

neurosurgical consultation, avoidance of early do-not-resuscitate orders, and increased use of intensive care for ICH patients.

This is where Code ICH comes in. The lessons from acute ischemic stroke are that success comes from coordinating people, place, plan, and process. Code ICH is this comprehensive, standardized protocol designed to guide the acute management of ICH patients. Key components of Code ICH include (Fig. 1):

- Rapid imaging. Immediate CT scans to confirm diagnosis and assess the extent of hemorrhage.
- Blood pressure management. Initiating smooth and sustained blood pressure control as soon as possible to prevent hematoma expansion.
- Anticoagulation reversal. For patients on anticoagulant therapy, timely reversal is critical to minimize further bleeding.
- Multidisciplinary team activation including neurology, intensive care, neurosurgery and emergency medicine teams to coordinate care.
- Continuous monitoring in ICU [13]: track the patient status (frequent neuro exams, pupillometry imaging), dynamically adjust treatment protocols, and vigi-

lantly monitor for adverse events, particularly thrombotic events, (subclinical) epilepsy, and infectious complications

Finally, a key component of Code ICH is quality improvement [14, 15]. It is not enough to have specific targets such as a 60-min time to initiation of coagulopathy reversal or time to achieve a blood pressure target. It is necessary to collect data in one's ICU and hospital to assess how often these metrics are being met, and then adjust the Code ICH protocol to improve on these.

Barriers may hinder the adoption of Code ICH, including resource limitations, variations in hospital capabilities, and nihilism regarding the prognosis of ICH patients. Addressing these barriers requires educating healthcare providers, standardizing protocols across institutions, and ensuring equitable access to advanced care for all patients.

Adopting Code ICH in intensive care units represents a significant shift in the management of intracerebral hemorrhage. Given that ICH patients are often sicker than ischemic stroke patients and that ICH care requires intensive care interventions such as intravenous blood pressure lowering and hemodynamic monitoring, the ICU is the right place around which to center this care. By standardizing early aggressive interventions and utilizing a bundled care approach, intensivists can significantly improve outcomes for ICH patients. The evidence supporting this approach is robust and growing, underscoring the urgent need for widespread implementation. Through dedicated efforts to overcome existing barriers, the healthcare community can ensure that all ICH patients receive the timely, high-quality care they need to maximize their chances of recovery.

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Declarations

Conflicts of interest
JCH and GC have no conflicts of interest related to the present work.

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